Diploma Programme
Programme du diplôme
Programa del Diploma

Biology
Higher level
Paper 2

12 May 2026

Zone A morning | **Zone B** morning | **Zone C** morning

Session number

2 hours 30 minutes

Instructions to students

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer two questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[80 marks]**.

2226–4018

19 pages

Section A

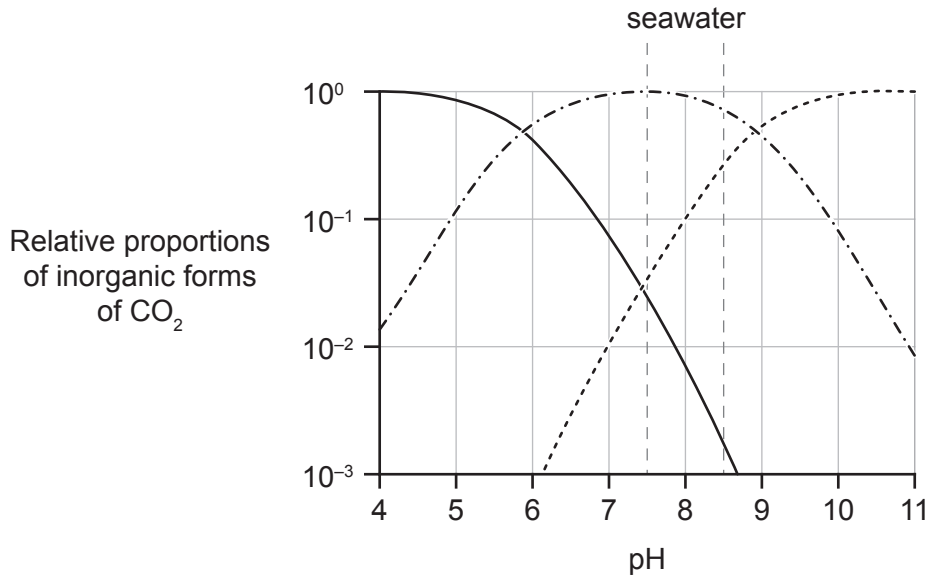
Answer **all** questions. Answers must be written within the answer boxes provided.

1. In the oceans, carbon dioxide (CO_2) dissolved in seawater exists in three main inorganic forms: aqueous CO_2, bicarbonate ions (HCO_3^-) and carbonate ions (CO_3^{2-}). All three forms of dissolved CO_2 are important for the biological processes of marine organisms. Oceans have an average pH globally of about 8.2. However, pH can vary by ± 0.3 due to local, regional and seasonal factors.

The graph shows the relative proportions of inorganic forms of CO_2 dissolved in seawater at a range of pH levels. The range of pH that is likely to be found in the oceans now and in the future is pH 7.5–8.5.

Key:

—— aqueous CO_2 –·– bicarbonate ions (HCO_3^-) --- carbonate ions (CO_3^{2-})



(a) Identify the form of dissolved CO_2 that is most abundant in seawater. [1]

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(b) State the relationship between aqueous CO_2 and carbonate ions (CO_3^{2-}). [1]

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(Question 1 continued)

(c) Identify **one** natural factor that might influence the pH of seawater. [1]

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Scientists have predicted that the oceans may change in the year 2100 due to CO_2 emissions from industry. The table shows past and two predicted changes to atmospheric CO_2, ocean composition and pH. The predictions were estimated using modelling techniques for the year 2100.

	Pre-industrial (mid-1800s levels)	**2005 levels**	**2× pre-industrial levels**	**6× pre-industrial levels**
Atmospheric concentration of CO_2 / parts per million	280	380	560	1680
HCO_3^- / mol kg^{-1}	1768	1867	1976	2183
CO_3^{2-} / mol kg^{-1}	225	185	141	57
Total dissolved inorganic carbon / mol kg^{-1}	2003	2065	2136	2296
Average pH of oceans	8.18	8.07	7.92	7.49

(d) Calculate the percentage change of HCO_3^- from pre-industrial levels to the 2× pre-industrial levels estimate. [1]

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(e) Suggest a reason for the researchers modelling 2× and 6× pre-industrial levels estimates for the year 2100. [1]

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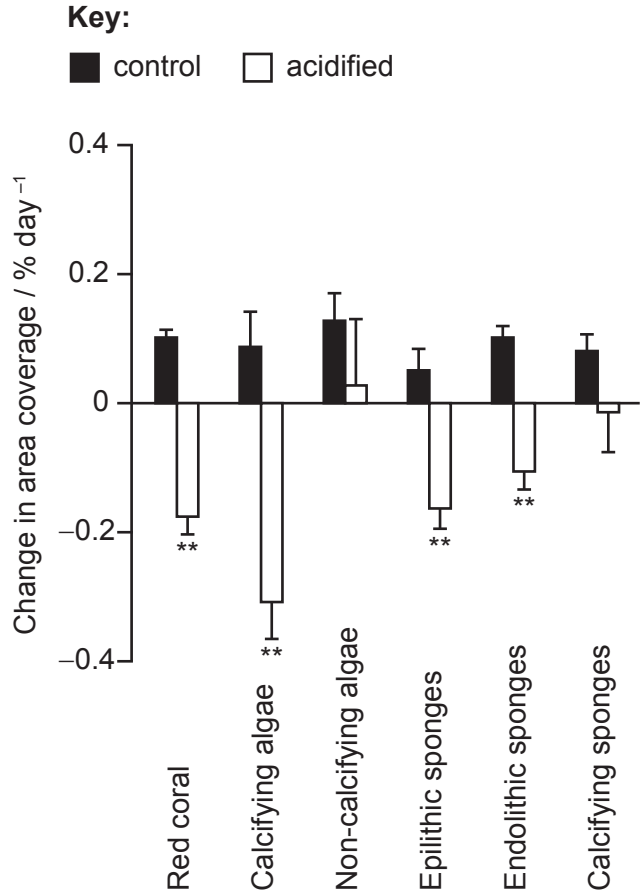
(Question 1 continued)

A separate study investigated the effect of acidification on different reef species in mesocosms.

The graph shows the changes in the growth rates of different reef species when subjected to an acidification treatment and a control treatment. The growth rates are expressed as percentage change in area covered by the species.

Asterisks indicate significant differences (**$p < 0.01$) in the acidified treatment compared with the respective control.



(f) Outline a possible control treatment. [1]

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(Question 1 continued)

(g) Compare and contrast the effects of the treatments on the calcifying and non-calcifying algae. [3]

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(h) Using all the data provided, predict the impact of CO_2 levels on reef species by the year 2100. [3]

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2. (a) Draw a labelled diagram to show the components of an RNA nucleotide. [3]

(b) State the type of chemical reaction that joins two nucleotides. [1]

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(c) Outline the production of mRNA by transcription. [3]

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(d) Describe how mRNA is modified before leaving the nucleus. [2]

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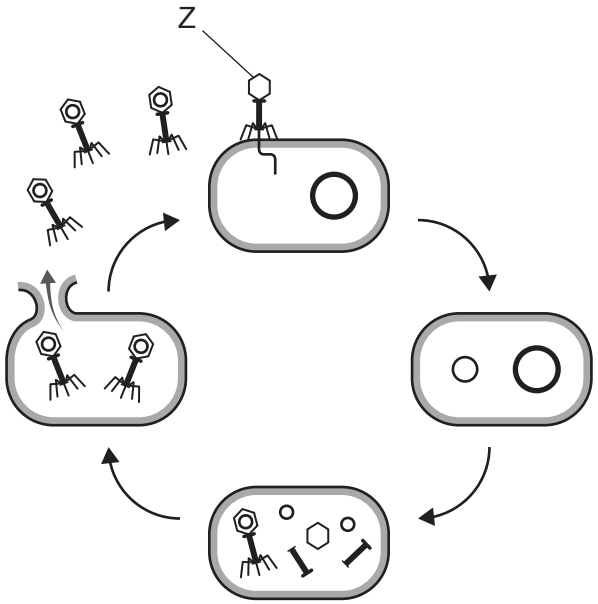
3. The diagram shows viral replication.



(a) State the name of the viral structure labelled Z. [1]

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(b) Identify the type of life cycle shown in the diagram, giving a reason for your choice. [2]

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(c) State the mode of existence of all viruses. [1]

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(d) Discuss the evidence for several origins of viruses. [2]

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4. Compare and contrast the organelles in animal and fungal cells. [4]

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5. (a) The table shows some information about the endocrine system. State the gland, hormone and function missing from the table. [3]

Gland	Hormone	Function
pineal	. . . . .	circadian rhythm
. . . . .	epinephrine (adrenaline)	fight-or-flight response
pituitary	antidiuretic hormone	. . . . .

(b) The pancreas produces the hormone glucagon. Explain how glucagon is used to maintain constant blood glucose levels. [3]

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6. The CCR5Δ32 allele has been linked to resistance to bubonic plague, although these claims are controversial.

(a) State the cause of a new allele forming. [1]

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(b) The infectious disease bubonic plague transfers from other species to humans. State the name for this type of disease. [1]

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(c) The frequency of the CCR5Δ32 allele is higher in areas where bubonic plague is common. Explain the reason for this. [3]

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7. (a) State the name for a genotype of individuals with one dominant and one recessive allele. [1]

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(b) Distinguish between dominant and recessive alleles. [1]

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(c) Carriers are individuals who possess one allele for a genetic condition but have no symptoms of that condition. Phenylketonuria (PKU) is a human disease caused by a recessive allele (d). Construct a Punnett grid to show the probability that two carrier parents will have a child with PKU. [2]

(d) Haemophilia is a genetic disorder. Explain the reason that males cannot be carriers of this condition. [2]

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Section B

Answer **two** questions. One additional mark is available for the construction of your answers for each question. Answers must be written within the answer boxes provided.

8. Blood transports gases such as carbon dioxide and oxygen.

(a) Outline the structure of a haemoglobin molecule. [3]

(b) Explain how the Bohr shift allows more oxygen to be supplied to actively respiring tissues. [8]

(c) Describe the adaptations of red blood cells (erythrocytes) to their function. [4]

9. Animals are adapted to survive in many habitats.

(a) Outline how animal cell membranes are adapted to habitats of different temperatures. [3]

(b) Describe the adaptations of herbivores for feeding on plants and of plants for resisting herbivory. [5]

(c) Explain how the abiotic features of a hot desert biome result in **three** adaptations of a **named** animal for survival. [7]

10. Membranes are important for allowing substances to move in and out of cells and organelles.

(a) Outline the changes that occur to plant cells when plant tissue is bathed in a hypotonic solution. [4]

(b) Describe how a resting potential is established and maintained. [4]

(c) Explain the role of the electron transport chain in the generation of ATP by cellular respiration. [7]

References:

1.(a) and (d) Raven, J., et al., 2005. [PDF online] Available at: https://royalsociety.org/-/media/policy/publications/2005/9634.pdf [Accessed 9 April 2025]. Reference redacted. Source adapted.

1.(f) Rastelli, E., Petani, B., Corinaldesi, C., et al., 2020. *Sci Rep* 10, 2948. [e-journal] https://doi.org/10.1038/s41598-020-59886-4. Reference redacted. Source adapted.

3. Kim, S.-M., Heo, H., Kim, C. and Shin, H., 2024. *Frontiers in Bioengineering and Biotechnology* 12. [e-journal] https://doi.org/10.3389/fbioe.2024.1319830. Reference redacted. Source adapted.